THE STATE OF RESPONSIVE IMAGES IN 2015

BY PADDI MACDONNELL • WEB DESIGN • AUG 18, 2015

The Web is a visual medium. The vast majority of that visual landscape is thanks to image files. Whilst plenty can be achieved with CSS, and inline SVG, most sites still need image files.

On average, images accounted for **more than half** of page size last year, and year on year image sizes increase; there was a **21% growth** in image size in 2014 alone.

At the same time, the number, and diversity, of devices accessing the web continues to grow. **Resolutions now vary** anywhere between 72ppi (decreasingly common) and over 600ppi.

Creating an image for the screen that will be of sufficient quality for any device is simple: save it at 1000ppi and call it a day. The resulting image will be crisp on even the highest of hi-res devices. But while your quality will be high, so also will your filesize. With page load time a **key factor in UX** it's incumbent on us to ensure that sites are delivered to our users promptly. When images are of such high quality that they take a dozen seconds to download on broadband connections, let alone mobile connections, then they are effectively unusable.

The aim of responsive images then, is not to deliver a higher quality image to screens that can display it (which we can do easily), the aim is to deliver the highest quality image supported *and nothing more.*

This guide is designed to teach you what works, where the problems and pitfalls still lie, and how you can use responsive images in websites, today.

I FEEL THE NEED, THE NEED FOR SPEED

Why does speed matter? Surely no one is on a 3G connection any longer? Nobody uses dial-up. If your client's target demographic inhabit urban Manhattan, why should you care about rural Lesotho? The fact is, it's a myth that we're all on super-fast broadband, sold to us by companies that profit from the desire for ever increasing speeds.

Most people spend at least two hours of every day on an inferior connection. I often find myself with most time to browse when commuting, when even a reliable 3G connection sounds like some far away dream.

In April **Google announced** that mobile friendliness would be used as a ranking factor for searches conducted on devices it considers to be "mobile". Even before that, **speed was a factor** in page ranking — both explicitly as part of Google's calculations, and implicitly as a contributing factor to your bounce rate.

In two identically ranked sites, an extra 1Kb could drop you from 3rd spot on Google, to 4th, or 5th. It could even drop you from 10th to 11th — in other words from page 1 to page 2 — with all of the associated impact on your client's revenue.

DO YOU REALLY NEED THAT IMAGE?

The most highly optimized image there is, is no image at all. If you have five images on your site and you drop one, you've saved yourself 20%, perhaps more importantly, you've saved yourself an http request. If we dropped all images from our sites, we'd save ourselves 100%, and all five http requests. So why not do that?

We don't drop images from our sites because they communicate more effectively than text in the short term. They create an emotional connection that draws users into content.

We know that **users don't read web pages**. Very few people read in-depth content online. Images allow us to connect with, communicate, and reinforce a brand in a fraction of the time that text can manage.

Images may be large, and unwieldy to download, but once rendered in the browser they are far more efficient than than text for establishing user engagement and reinforcing a brand message.

Responsive images help us ensure that the emotional connection images build isn't lost when the impatient user hits the back button.

HOW ABOUT SVG?

SVG (Scaleable Vector Graphics) is one of the true pioneering technologies of the Web. It's so far ahead of the curve that most designers still haven't recognized its true potential.

SVG — as the name implies — is vector based. This means that SVG graphics are constructed from points, angles, and distances. SVG is also — as the name implies — scaleable, meaning that it will display equally well on a 5k iMac or an Android smartphone, with no loss of quality and no change in file size.

If you have a flat illustration, an icon, a logo, just about anything that can be displayed as an SVG, then SVG is the way to go.

Most images on the Web are bitmaps. Generally speaking the way a bitmap works is to describe each pixel one at a time, its color (in RGB — red, green, and blue values) and in some cases its transparency. If you have an image measuring 100px by 100px, then you have an image with 10,000 pixels; if each pixel has 4 values to describe it, then the image has 40,000 bits of data associated with it. Sounds like a lot doesn't it? Sometimes, that's less than a vector graphic.

Consider a 1px by 1px image; that would require 4 bits of data to record as a bitmap (red, green, blue and alpha values). Now consider the same square pixel recorded as a vector; that would require the x, y, width, and height of the rectangle, in addition to the RGBA values.

Those are crude examples, but they're accurate. Often, a vector version of an image — if we even have one available to us — exceeds the file size of the equivalent bitmap, and then bitmap is the only sensible choice.

(MIS)USING JAVASCRIPT

Like most problems in life (if your life is online) responsive images can be solved by JavaScript. In fact for a number of years JavaScript was the only way to solve the issue. JavaScript can test a user agent's abilities, determine what kind of browser it is, and write a standard HTML image tag, containing the appropriate image.

Web designers who object to using JavaScript typically do so because **some people turn it off**. However, that's not really the case any longer, especially on the mobile web, but there are some persistent issues: writing an image with JavaScript means that the image won't be parsed by search engine bots, and it will only render after the script as run, for example.

The biggest issue with using JavaScript is that it's a misuse of JavaScript's core purpose. HTML holds data, CSS handles presentation, JavaScript handles functionality. When we break from those structured roles we start to encounter problems that require hacks to fix them. Images are data, and should be therefore be handled by HTML.

THE TROUBLE WITH BROWSERS

Since RWD was first thought up, images have been the biggest stumbling block. But now, we're starting to find ways to solve the various problems. Techniques that are battle-hardened and successful enough to be considered best-practice. Dedicated developers have given up their time to lobby the WC3 for official solutions, and now, for the first time, responsive images are practical.

The key to responsive images, is that they have been designed with a full awareness of the failings of the Web. Care has been taken to ensure that responsive image solutions do not break existing browsers, so that even in browsers that do not support responsive images, the code will fail silently and non-responsive, default images will be displayed.

In this article we'll be looking at two official responsive image HTML elements: *srcset* and *picture.*

At present, Edge, Safari, and iOS Safari only support a subset of the *srcset* specification. Firefox, Chrome, Opera, Android Browser, and the forthcoming versions of Safari and iOS Safari fully support it. (We'll discuss the differences below.)

At present the *picture* element is fully supported by Firefox, Chrome, Opera, and Android Browser. Edge, Safari, and iOS Safari don't support it, and they haven't announced a timetable for implementing it.

Even among browsers that do support the new code, there are inconsistencies as different browser manufacturers interpret the W3C specifications in different ways. For example, when specifying a change of image from small to large based on viewport size, some browsers will switch to the large image when the viewport is 1px larger than the small image's preferred size, others will switch to the large image only when the viewport favored by the large image is fully matched.

In summary, browsers are split into two camps: those that favor higher quality images where possible, and those that favor smaller downloads where possible. Browser manufacturers are still duking this one out, eventually someone's implementation will be proven most popular — personally I hope it's the latter, because as noted above performance is crucial to user experience.

For now, the best option for web designers is to stick to the specification and don't try to second guess the browser. After all, the default experience in the browser (higher quality, or faster downloads) is part of what a user selects a default browser for, so if the user is aware of the different approaches, then the browser preference is likely the user's preference also.

RESPONSIVE IMAGE BEST-PRACTICE (2015)

Throughout the Web's history, we've used one element to indicate an image, the *img* element. In HTML5, the *img* element has undergone a subtle shift in its role, one that is designed to enable responsive images: the *img* element no longer represents an image, it is now a placeholder for an image.

That distinction is important, because whilst an *img* element previously held a single set of image data — be that bitmap or vector — now an image can hold multiple sets of data.

The *img* element (to recap for any non-coders) looks like this:

```
<img src="" alt="" />
```

The responsive image version of the *img* element looks like this:

```
<img srcset="" src="" alt="" />
```

Barely any change at all. Looking at this code, you notice one important thing: the code is backwards compatible. If a browser happens along that doesn't understand the *srcset* attribute, it will simply ignore it and render the image according to the original 1993 specification.

What this means, is that we can now use responsive images in our markup, without the need for feature detection.

In the new responsive *img* element, *src* is principally used as a default image and for browsers that don’t recognize *srcset,* whereas *srcset* contains all of the available high-res format images for that placeholder.

When rendering the *img* element the browser will determine for itself which image file is the most appropriate.

Using srcset

Now that we know that *srcset* will fail silently in browsers that don’t support it, we’re free to add an extra image:

```
<img srcset="image-b.jpg" src="image-a.jpg" alt="an image" />
```

In this case, any browser that supports *srcset* will display *image-b.jpg* and any browser that does not support *srcset* will display *image-a.jpg.*

It’s important to note that the browser will only download the image it decides it wants to display, it doesn’t download both images and then choose one.

Sadly this doesn’t get us very far, because unless we’re demonstrating *srcset* support, there’s no practical application for switching images based on *srcset* support alone.

The solution is to provide additional information to the browser about which image it should choose. In order to do that, we need to supply information about either available space, or pixel density.

Using x-descriptor

The *x-descriptor* tells a browser how dense the pixels in an image are.

If for example, you wanted to provide a retina-grade image with twice the number of pixels as a standard image, you’d specify the retina image in the *srcset,* followed by a space, and then the keyword “2x”.

We have our image:

```
<img src="image.jpg" alt="an image" />
```

In order to add a retina option for the browser, we add the following srcset:

```
<img srcset="retina-image.jpg 2x" src="image.jpg" alt="an image" />
```

In this case, there are three possible outcomes:

1. if the browser does not support *srcset* it will use the image file specified in the *src* attribute;
2. if the browser does support *srcset,* and has a screen capable of a double resolution, it will use the image specified in the srcset attribute;
3. if the browser does support *srcset* but doesn't have a high-res screen, it will use the image specified in the *src* attribute (when no "1x" image is specified in the *srcset* attribute, the *src* attribute is assumed to be that image option).

Browser support is good, and rapidly improving. With one attribute we've solved the conundrum of responsive images, yay us!

One last thing to note about the x-descriptor: the choice of which image to load is based on pixel density, so if a user zooms their browser to 200% (effectively halving the image size, and so doubling the pixel density) the *2x* image will load. This can have a detrimental effect on accessibility — we certainly don't want to see sites loading slower for the visually impaired, simply because they choose to zoom their browser.

Using w-descriptor

The *w-descriptor* is a little more advanced than the *x-descriptor.* The *w-descriptor* works by telling the browser how many actual pixels exist on the x-axis (the width) of a particular image option.

Edge, Safari, and iOS Safari do not support *w-descriptor* at the time of writing, so its usefulness is somewhat reduced.

Let's return to our original image:

```
<img src="image.jpg" alt="an image" />
```

If this image is natively 1600 pixels wide and if we want to add a retina image, as we did with the *x-descriptor* above, we'd specify an image in the *srcset* attribute that is 3200 pixels wide:

```
<img srcset="retina-image.jpg 3200w" src="image.jpg" alt="an image" />
```

There is one major gotcha with the *w-descriptor:* although the *src* attribute is treated as the default when specifying images using the *x-descriptor,* it is ignored altogether by browsers that support *srcset* if you use the *w-descriptor.* When using the *w-descriptor* we have to specify the default explicitly by adding a second *srcset* image option, with its own *w-descriptor,* and separating them with a comma:

```
<img srcset="retina-image.jpg 3200w, image.jpg 1600w" src="image.jpg" alt="ar
```

Which leads us neatly onto…

Using multiple images

Being able to specify a high resolution image option for the browser right in our HTML code is decidedly cool, but as you probably guessed, is gets even cooler when we specify multiple images.

The goal of responsive images is to deliver the best quality image usable by the accessing device, but nothing more. So simply supplying a retina image isn't adequate, we need to supply images at, for example, 1x, 1.5x, 2x, 2.5x, and 3x.

Once again, here's our original image markup:

```
<img src="image.jpg" alt="an image" />
```

Here it is with a retina grade image supplied as an option for the browser:

```
<img srcset="retina-image.jpg 2x" src="image.jpg" alt="an image" />
```

Here it is, this time with extra options in the *srcset,* separated by commas:

```
<img srcset="huge-image.jpg 3x, retina-image 2x, moderate-image 1.5x" src="im
```

Because keywords mean different things to different people, I find it advisable to name my images according to the *x-descriptor* to which they belong, both as a personal memory aid, and to ensure the different sizes are clear to other team members:

```
<img srcset="image_3x.jpg 3x, image_2x.jpg 2x, image_1-5.jpg 1.5x" src="image
```

Remember, we're not telling the browser what image to display, we're letting it know the options that are available to it, and allowing it to select for itself. The browser will only download one of these images.

One gotcha with multiple images: don't ever specify two images in the *srcset* attribute with a matching *x-descriptor* and *w-descriptor,* for example:

```
<img srcset="cross-the-streams.jpg 2x, cross-the-streams.jpg 3200w" src="imag
```

It would be bad...

Using sizes

The *sizes* attribute is a particularly interesting addition to the specification, because the *sizes* attribute takes its values relative to the viewport, not the image.

Using the *vw* (viewport width) value, we specify the image area relative to the browser width — remember, the *img* element is now effectively just a placeholder, so we're not specifying the actual size of the image, we're specifying the size of placeholder that will contain the image.

100vw is 100% of the viewport width, 50vw is 50% of the viewport width, 25vw is 25% of the viewport width, etc.

If we wanted to set the *img* width to half of the browser width, we'd use:

```
<img sizes="50vw" srcset="retina-image.jpg 2x" src="image.jpg" alt="an image"
```

This isn't particularly useful, until we combine it with media queries…

Using media queries

The *sizes* attribute becomes much more powerful when we combine it with media queries. We can separate multiple viewport widths using commas, and tell the browser which to use by using a CSS style media query.

For example, imagine that we want an image to make up 80% of the width of our viewport on the majority of devices, but on small devices (like phones) with a width of 380px or less, we want to make the most of the space available by making up 100% of the width, we'd write that like this:

```
<img sizes="(max-width: 380px) 100vw, 80vw" srcset="retina-image.jpg 2x" src=
```

Following this logic, any browser with a viewport of 380px or less will set the width of the image to 100% of the viewport. Any other browser will cause the media query to return false and the browser will move to the next value of the *sizes* attribute, which in this case is 80vw.

As a general rule, I'm uncomfortable using media queries in HTML. Just as responsive image data belongs in HTML (not JavaScript), media queries belong in CSS (not HTML). However, the option is there for you if you need it.

RESPONSIVE IMAGE BEST-PRACTICE (2016?)

I don't know about you, but I'm pretty excited by the possibilities of *srcset.* It's a simple solution to a difficult problem, and seems to deliver everything we need.

But, like buses, you wait 20 years for an official solution to responsive images, and then two turn up at once. As well as the *srcset* attribute of the *img* element, we also have the *picture* element.

The *picture* element is another placeholder, albeit a more traditional one. It has been engineered to mimic the *video* and *audio* elements in HTML5, so its syntax will be familiar to most. The *picture* element is intended to be used when you need more control than *srcset* can provide.

Sadly, the *picture* element has far less browser support than *srcset* and it doesn't always fail silently.

Using the picture element

Here's our original image element:

```
<img src="image.jpg" alt="an image" />
```

Here's our image nested inside a picture element:

```
<picture>

<img src="image.jpg" alt="an image" />
```

```
</picture>
```

We can also specify a *srcset* for an *img* element inside a *picture* element:

```
<picture>


<img srcset="retina-image.jpg 2x" src="image.jpg" alt="an image" />

</picture>
```

Using the source element

The *picture* element doesn't come to life until we add the *source* element:

```
<picture>


<source />


<img src="image.jpg" alt="an image" />

</picture>
```

When selecting which file to use, the browser will start with the first *source* element, and move through the elements until it finds one whose *media* attribute resolves to true, it will then use that *source* element's *srcset.*

For example, we could specify different images for portrait and landscape formats:

```
<picture>


<source media="orientation:landscape" srcset="horizontal-image.jpg" />


<source media="orientation:portrait" srcset="vertical-image.jpg" />
```

```
<img src="image.jpg" alt="an image" />

</picture>
```

We can also specify multiple images using *x-descriptor* and *w-descriptor:*

```
<picture>


<source media="orientation:landscape" srcset="retina-horizontal-image.jpg
2x, horizontal-image.jpg" />


<source media="orientation:portrait" srcset="retina-vertical-image.jpg 2x,
vertical-image.jpg" />


<img src="image.jpg" alt="an image" />

</picture>
```

As with the use of media queries in the *sizes* attribute, I'd question the wisdom of controlling image versions based on style, in markup instead of a stylesheet. However, the option to use the *media* attribute is there if you need it.

Using type

The *picture* element really comes into its own when used to swap out different types of images.

Imagine we have a standard PNG file, but we want to use a **WebP file,** which is typically 26% smaller — remember responsive images are about delivering the best image quality, at the smallest size — but currently only supported by Chrome, Opera, and the Android browser. We'll need to use the *type* attribute to determine if WebP is supported:

```
<picture>


<source type="image/webp" srcset="retina-image.webp 2x, image.webp 1x" />
```

```
<img srcset="retina-image.jpg 2x" src="image.jpg" alt="an image" />

</picture>
```

In this case, the browser will check if the WebP image format is supported. If it is, it will determine if the screen has enough pixel density to display the *retina-image.webp* image, if not it will display the *image.webp* image. If WebP isn't supported the browser will jump straight to the *img* element and work through the *srcset* and *src* options in the way we're already familiar with.

The *type* attribute means that we can provide much smaller image formats where supported, resulting in a smaller file size.

Known issues

IE9 **has a known issue,** that prevents the picture element from failing silently. In order to handle IE9 you need to trick IE9 into thinking that the *source* elements are part of a *video* element:

```
<picture>

    < !–[if IE 9]>
<video style="display:none;">
< ![endif]–>

<source type="image/webp" srcset="retina-image.webp 2x, image.webp 1x" />

    < !–[if IE 9]>
</video>
< ![endif]–>

<img srcset="retina-image.jpg 2x" src="image.jpg" alt="an image" />

</picture>
```

It's an ugly solution, but better than no solution at all. We can only hope that the release of Windows 10 will hasten the demise of IE9, because while Edge doesn't yet support the *picture* element, it doesn't support it in the correct way (by ignoring it).

There are **polyfills** that can help you support the *picture* element on IE, but my own preference is to avoid them. I distrust patching problems with JavaScript, it impacts performance and leads to less maintainable code.

For this reason, I recommend avoiding the *picture* element for now. Unless you're running a large-scale ecommerce site, the extra saving on download time that the WebP format offers is unlikely to outweigh the inconvenience of patching your markup with script.

Once IE9 drops below 1%, which should happen at some point in the next year, the *picture* element will become viable. If you're reading this in 2016, you're probably good to go.

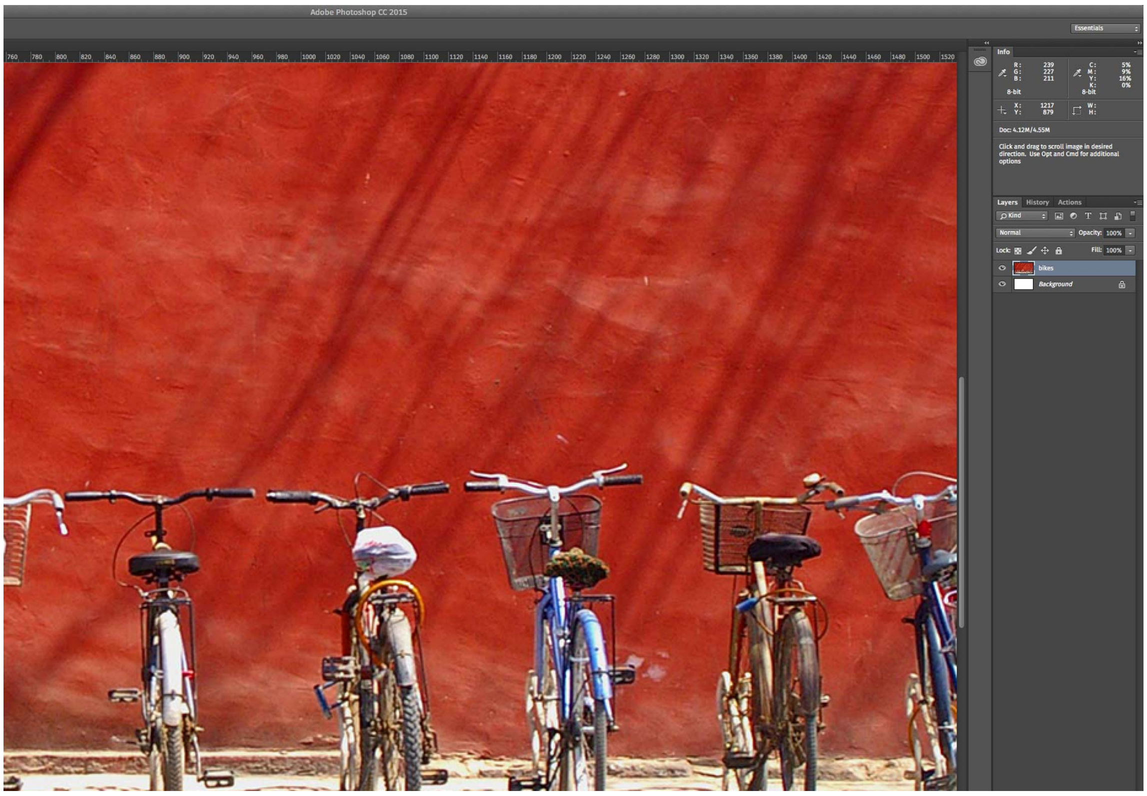
CREATING RESPONSIVE IMAGES

Unlike SVG, bitmap images don't scale up. Our strategy for handling them, whether we're using *srcset* or the *picture* element, is to supply a different image based on the browser's capabilities. In order to handle that, we need to supply a variety of different image sizes.

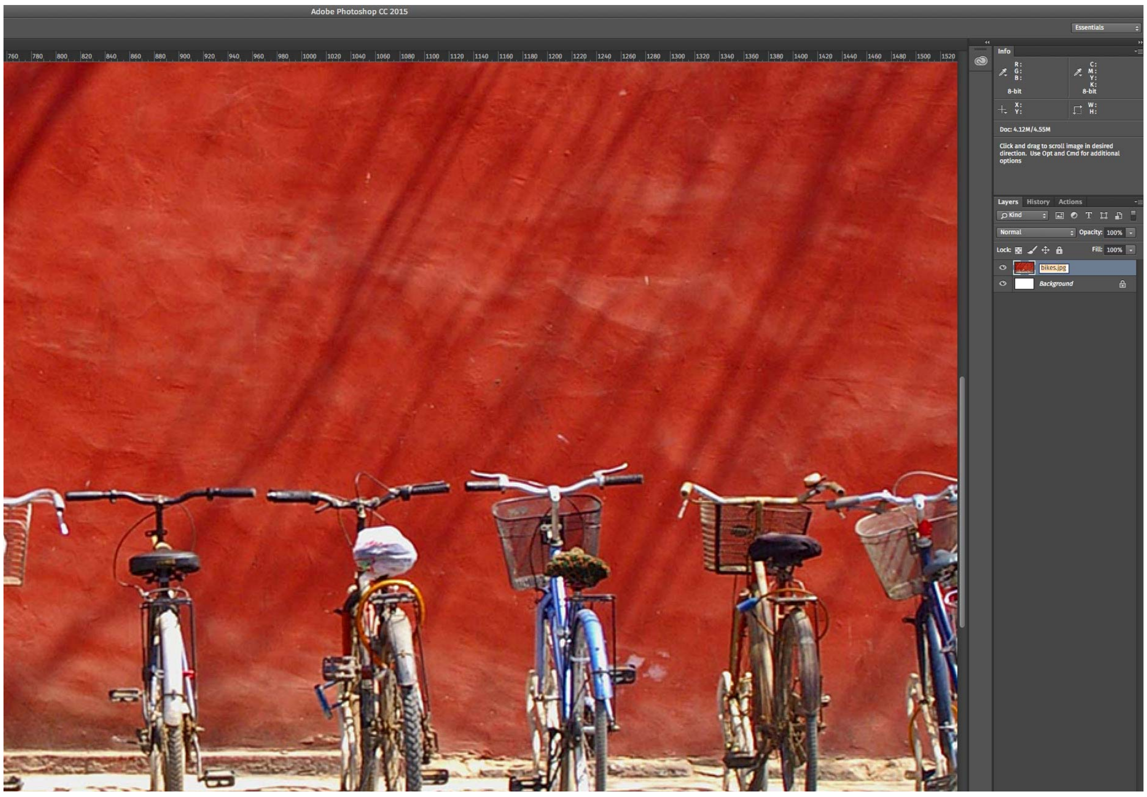
Most image editing applications have automated the process of exporting multiple versions of a single image. It doesn't matter which application you use, provided you end up with multiple image sizes without having to manually resize and save each one.

Adobe Photoshop is the de facto bitmap editor. It's not a great choice for design work, but its image processing workflow is smooth and reliable. Generating multiple image resolutions in Photoshop is relatively straightforward:

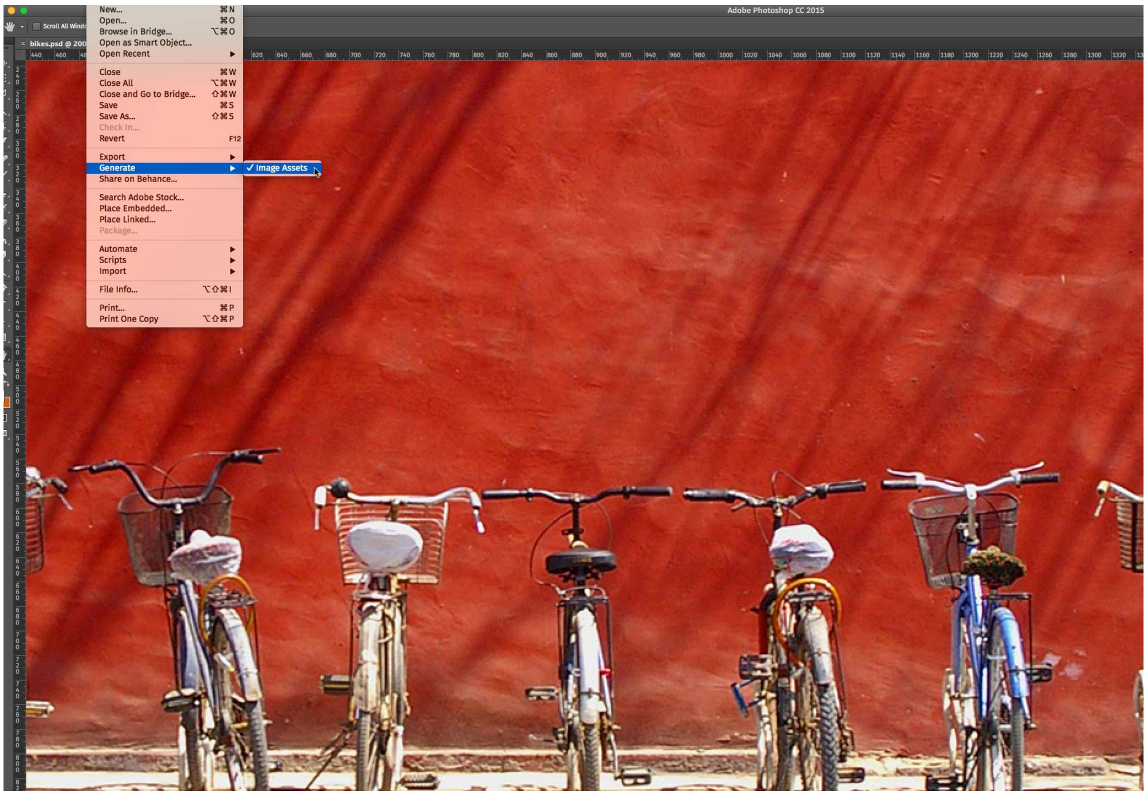
1. Open up the image you want to generate multiple versions of, and place it on its own layer.



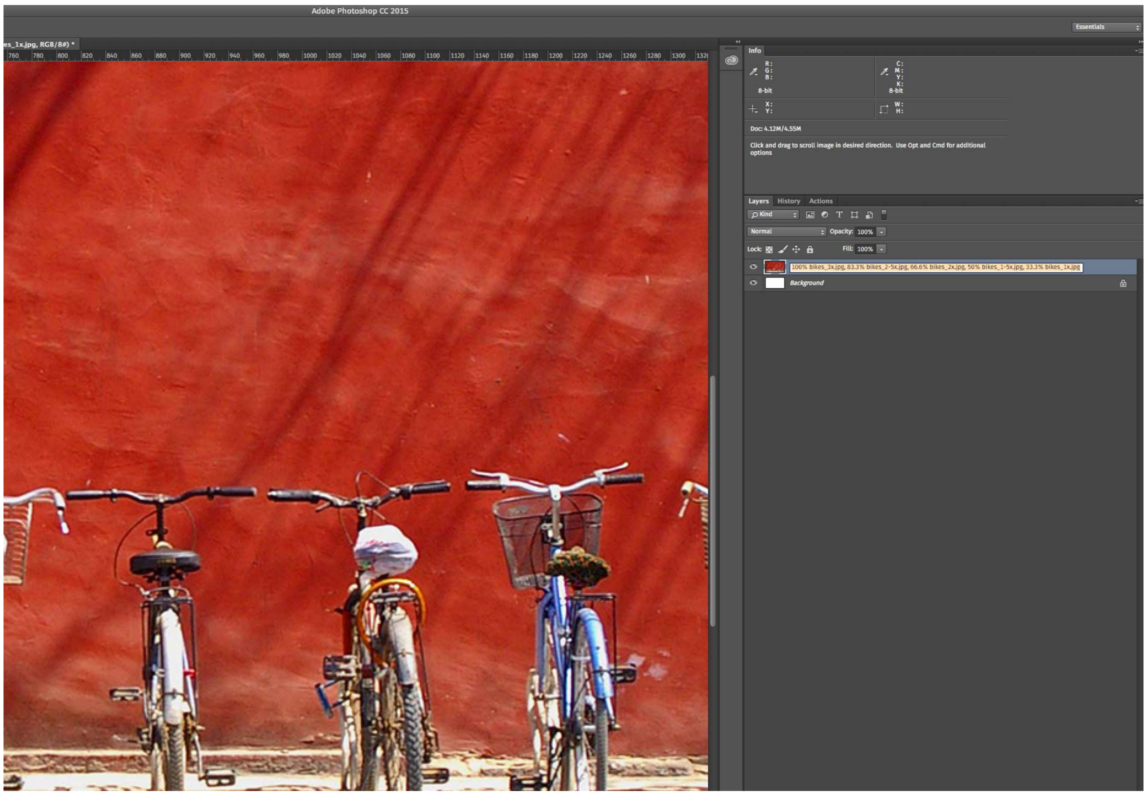
2. Rename the layer as the name of the file you want to generate (including the extension).



3. Select File > Generate > Image Assets and a folder with your new image will be saved alongside your PSD.



4. Rename the layer, specifying each image you want to generate preceded by its intended scale. You don't need to repeat step 3, once you rename the layer the images will be generated automatically.



100% bikes_3x.jpg, 83.3% bikes_2-5x.jpg, 66.6% bikes_2x.jpg, 50% bikes_1-5x.jpg, 33.3% bikes_1x.jpg

Credit for the image goes to ***Philip Collier****.*

For more information on generating images in Photoshop, **see here.**

Based on these images, we can offer the browser five different options:

```
<img srcset="bikes_3x.jpg 3x, bikes_2-5x.jpg 2.5x, bikes_2x.jpg 2x, bikes_1-5
```

CONCLUSION

The *img* element has come a long way in 20 years. Or, to be more accurate, the *img* element was inadequate for 18 years, then sprinted for the line in the last two years, to the point that it is now relatively sophisticated.

The important thing, is that we got to the solution(s).

Of the two options available, *srcset* and *picture,* the former is by far the most supported. If you're building 95% of the sites out there, then the superior support and simpler implementation of the *srcset* attribute is your best option.

If you’re running a large ecommerce site, with thousands of product images, the extra work to serve the WebP format may be worthwhile, especially as support for the *picture* element increases over the next couple of years.

The biggest weakness in the current options is that browsers don’t currently have a way of selecting an image based on their connection speed. We are forced to trust that more capable devices are also on superior connections.

Ultimately, we can finally serve the highest quality images practically possible, at the smallest size. That means a better experience, in a shorter time, which can only be something to embrace.

Featured image uses, ***mountain image*** *and* ***device image*** *via Shutterstock.*